

GOT ALUMINUM? REMOVING SUSPENDED METALS WITH PEAT BASED SORPTION MEDIA

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Overview

- ▣ Problem
- ▣ Peat Based Sorption Media
 - Why should it work?
- ▣ Testing
- ▣ Application
- ▣ On going work



West Virginia Mine Drainage Task Force

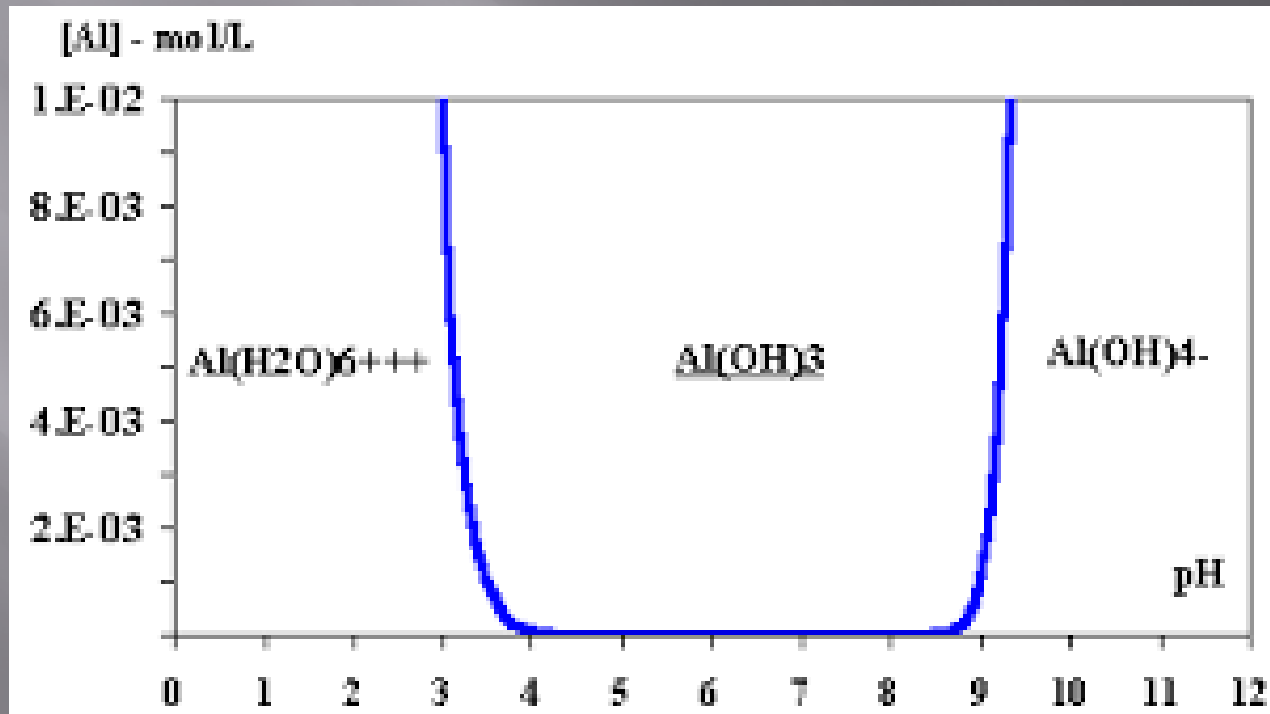


West Virginia Regulations

- ▣ Coal mine drainage
- ▣ pH 6-9
- ▣ Aluminum
 - Maximum 0.750 mg/l
 - Average 0.43 mg/l
- ▣ Guilty until proven innocent
 - Limits enforced as total



Aluminum Solubility



Is there an easy solution?

PBR to the rescue!



Peat Based Remediation

Peat based sorption media

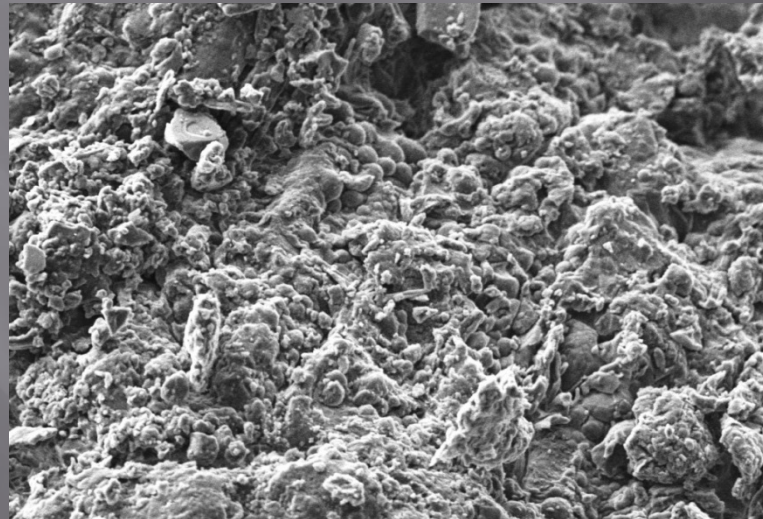
- ▣ Convert peat into engineered media
- ▣ APTsorbTM
 - Patented peat based sorption media
 - Hardened granule



APTTMsorb Granule

Properties

- ▣ Size 0.6 to 2 mm
- ▣ Large surface area
- ▣ High hydraulic conductivity (~ 1 cm/sec)
- ▣ High metal affinity (1-15% max dry wgt)



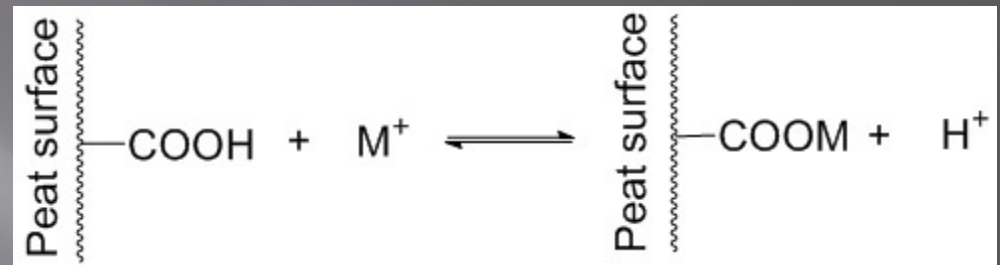
APT^{sorb}™ Granule 2000x

A large, dark, abstract sculpture of a figure, possibly a woman, with a prominent circular opening in its chest. The sculpture is set against a bright blue sky with scattered white clouds. The figure's head is tilted back, and its arms are raised, with one hand near the circular opening. The sculpture has a smooth, reflective surface.

Why would
this work?

Metal Removal Mechanisms

- ▣ Dissolved
 - Adsorption
 - Ion Exchange
 - Complexation
 - Chelation
- ▣ Particulate
 - Physical Filtration
 - Sorption



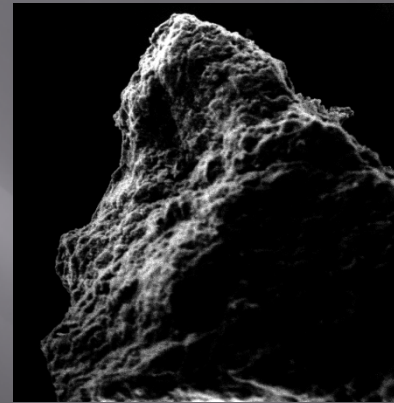
Surface Area

Fine Sand

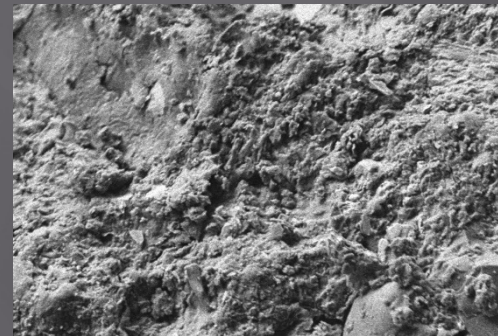


100 X

APT_{sorb}



1000 X



1500 X

Case Study

Soudan Mine



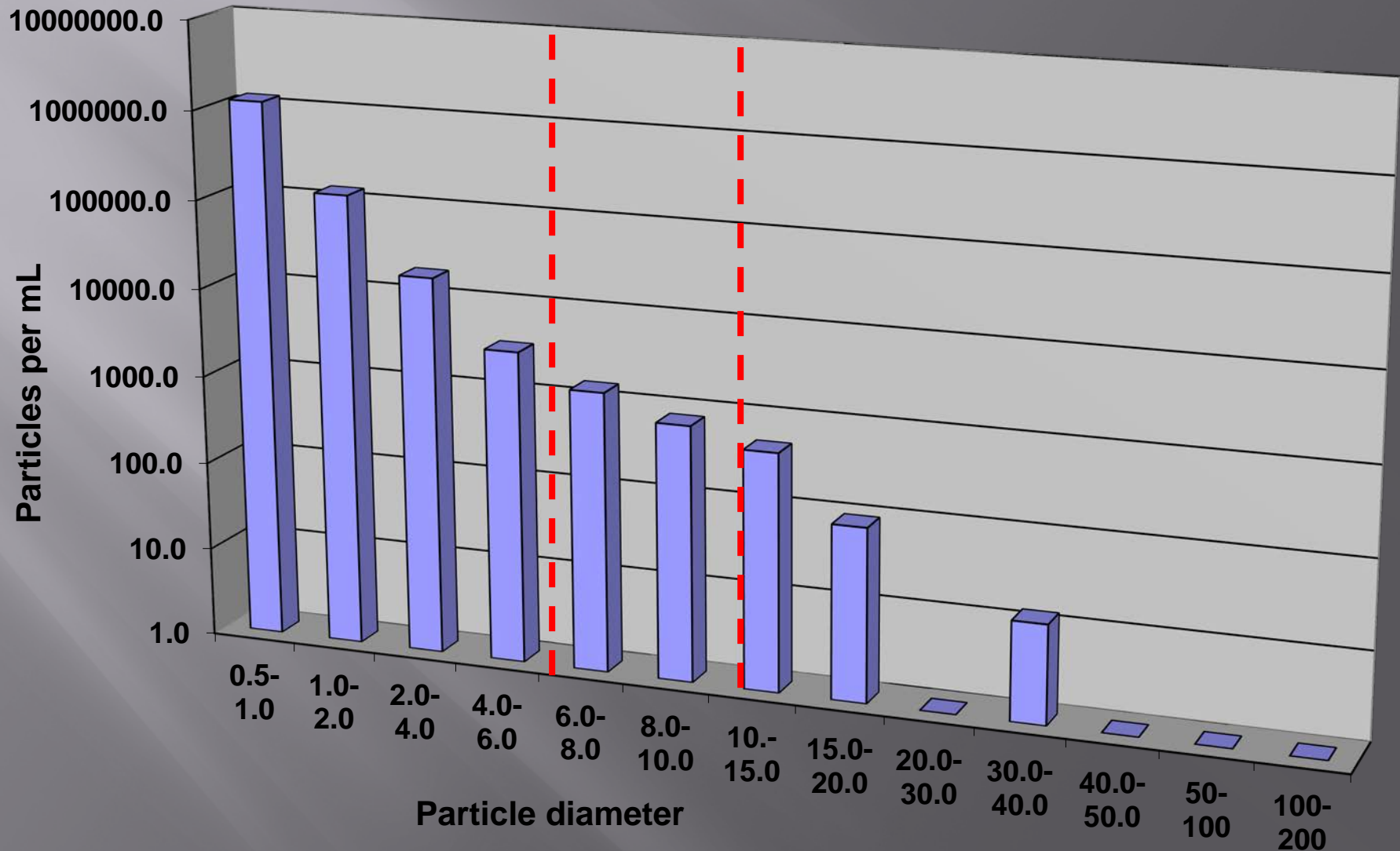
Soudan Mine

- ▣ Closed underground iron mine
- ▣ Minnesota State Park
- ▣ TSS 5-10 mg/L
- ▣ Mine water; 30 - 40 $\mu\text{g/L}$ Cu
- ▣ Permit limit: 17 $\mu\text{g/L}$
- ▣ 75 % is suspended

8-10 $\mu\text{g/L}$ dissolved < 17 $\mu\text{g/L}$



Particle Size Analysis, Input

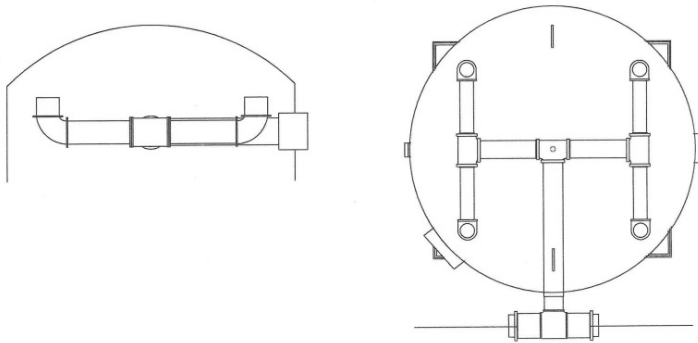


Pilot Study

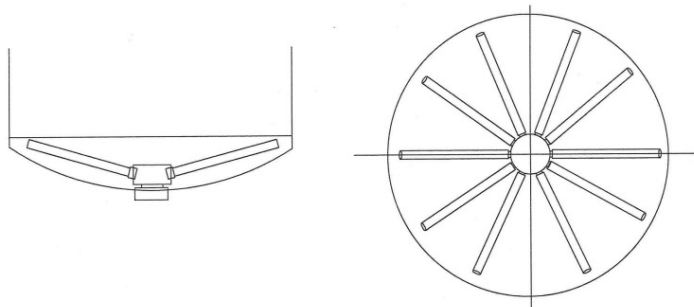
- ▣ Treatment tank
 - 1000 gallon
 - 500 gallons media
 - Typical flow 50 gpm
 - Contact time 10 min
 - Designed to backwash



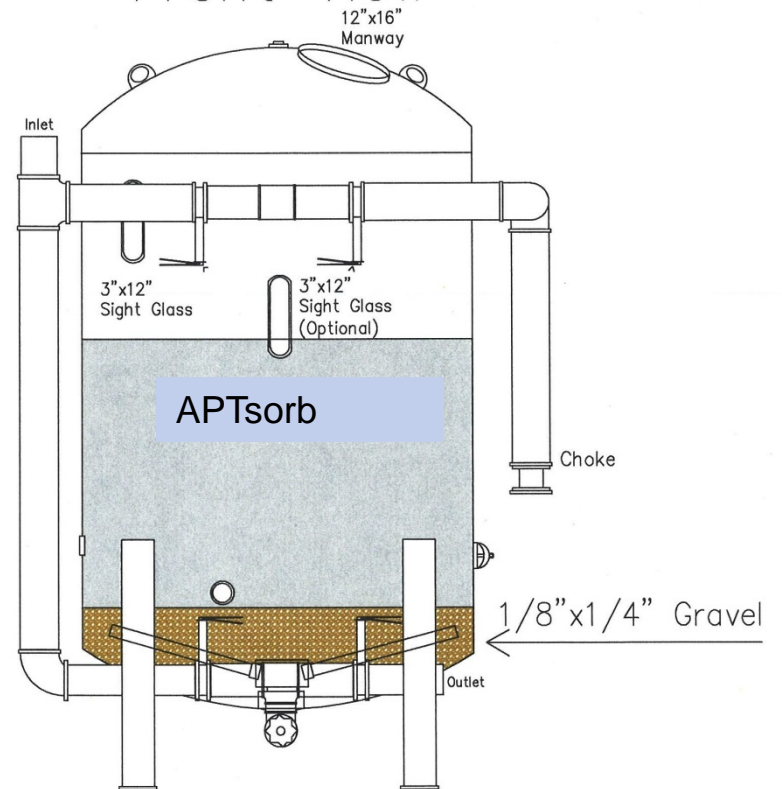
Top Manifold



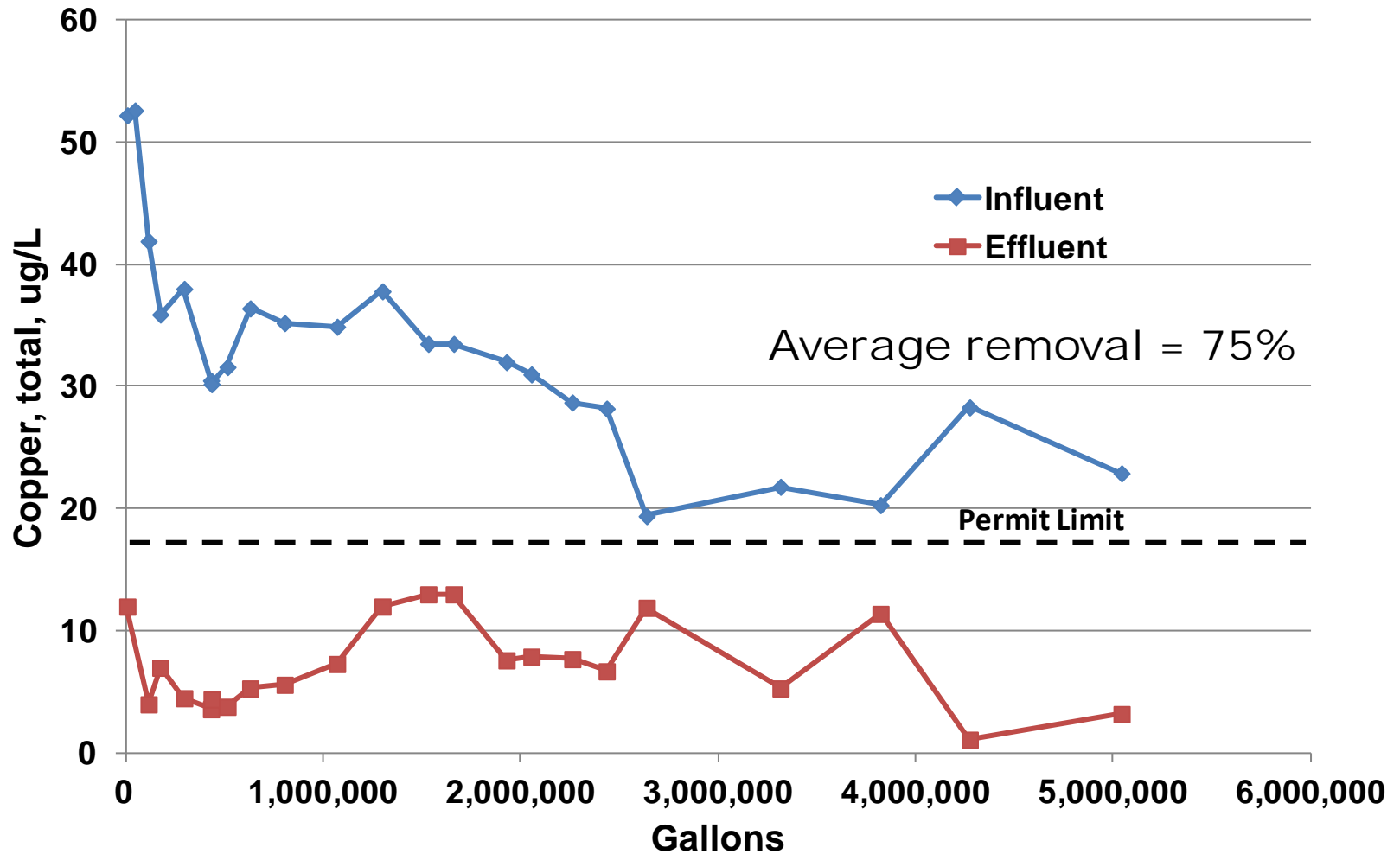
Bottom Manifold



Front View



Total Copper vs Time, Soudan Underground Mine November 2012- May 2013



Summary

- ▣ One year successful treatment
- ▣ Remotely monitored
- ▣ Minimal maintenance
- ▣ Backwash every 4-6 weeks
 - Eliminated solids from media
 - Restored pressure drop to initial value
- ▣ Cost < 25 cents / 1000 gallons

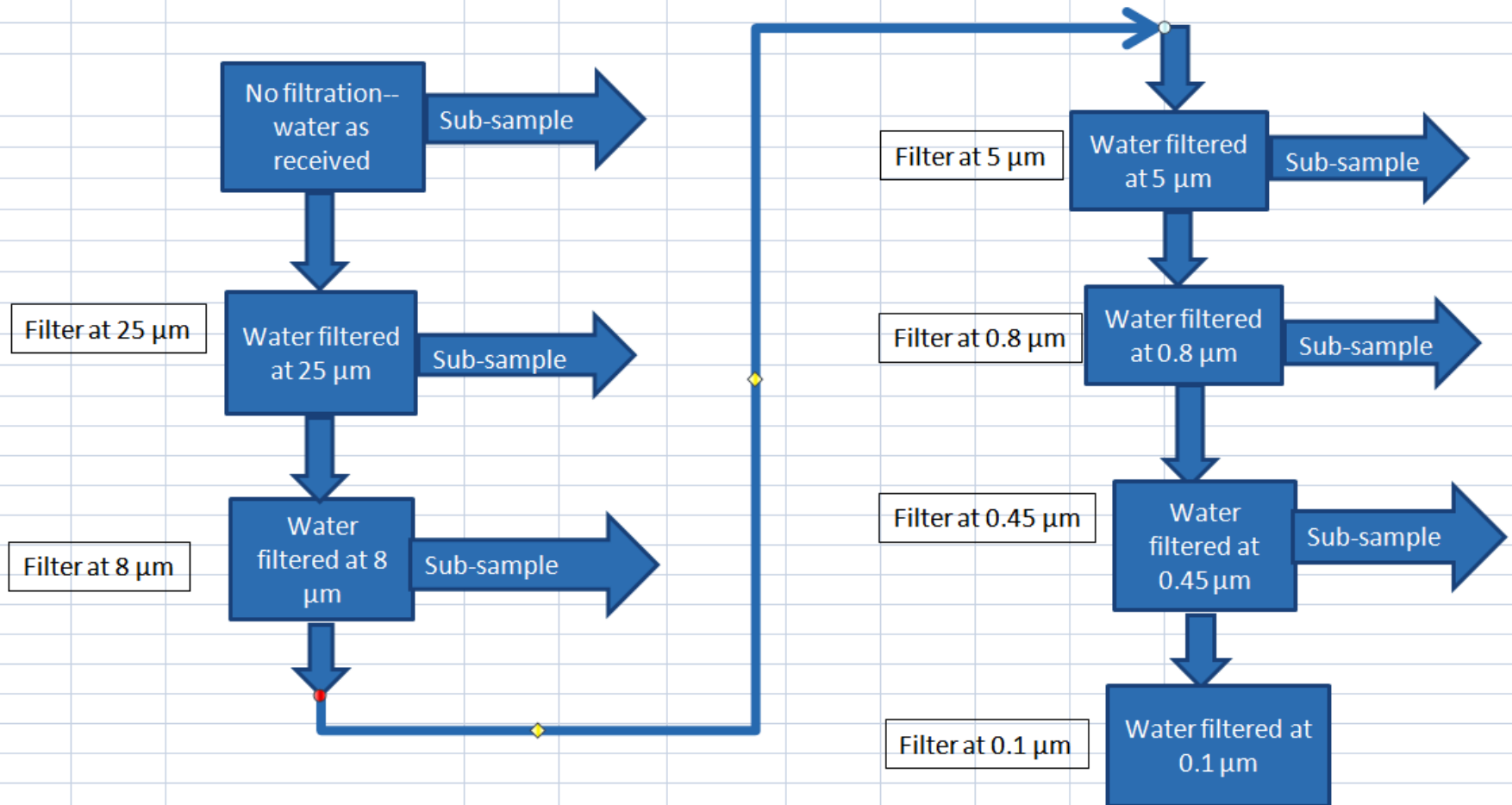
Suspended Aluminum



Sources of Water

- ▣ Treated coal mine drainage
- ▣ Active treatment process
 - Clarifier effluent
- ▣ Passive system effluent
 - Final pond effluent
- ▣ Typical water quality
 - pH 7-8
 - Al 0.5- 1.5 mg/L

Size Distribution



Particle Size, Active Treatment

Series filtration			
Clarifier Effluent	Al (ppb)	Percent removal	Particle size
No filtration	397	0	
25 μm	184	54	54% > 25 μm
8 μm	182	54	
5 μm	125	69	
0.8 μm	101	75	
0.45 μm	48	88	0.45 μm < 86%
0.1 μm	31	92	

pH 7.7

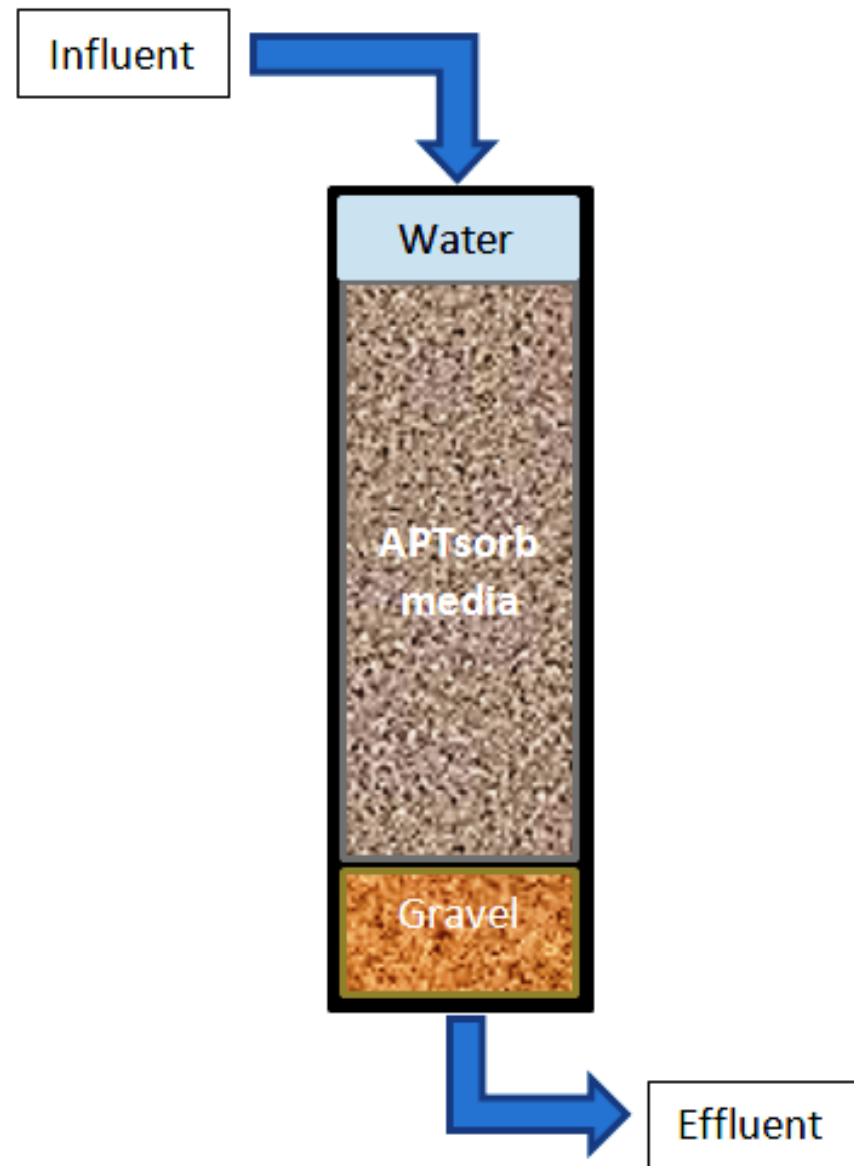
Particle Size, Passive Treatment

Series Filtration			
Pond effluent	Al (ppb)	% removal	Particle Size
No filtration	225.7	0%	
25μm	209.45	7%	
8.0μm	163.1	28%	
5.0 μm	26.78	88%	5μ<60%<8μ 88%>5 μ
0.8 μm	27.01	88%	
0.45 μm	26.88	88%	
0.20 μm	34.96	85%	
0.10 μm	35.15	84%	

pH 8.9

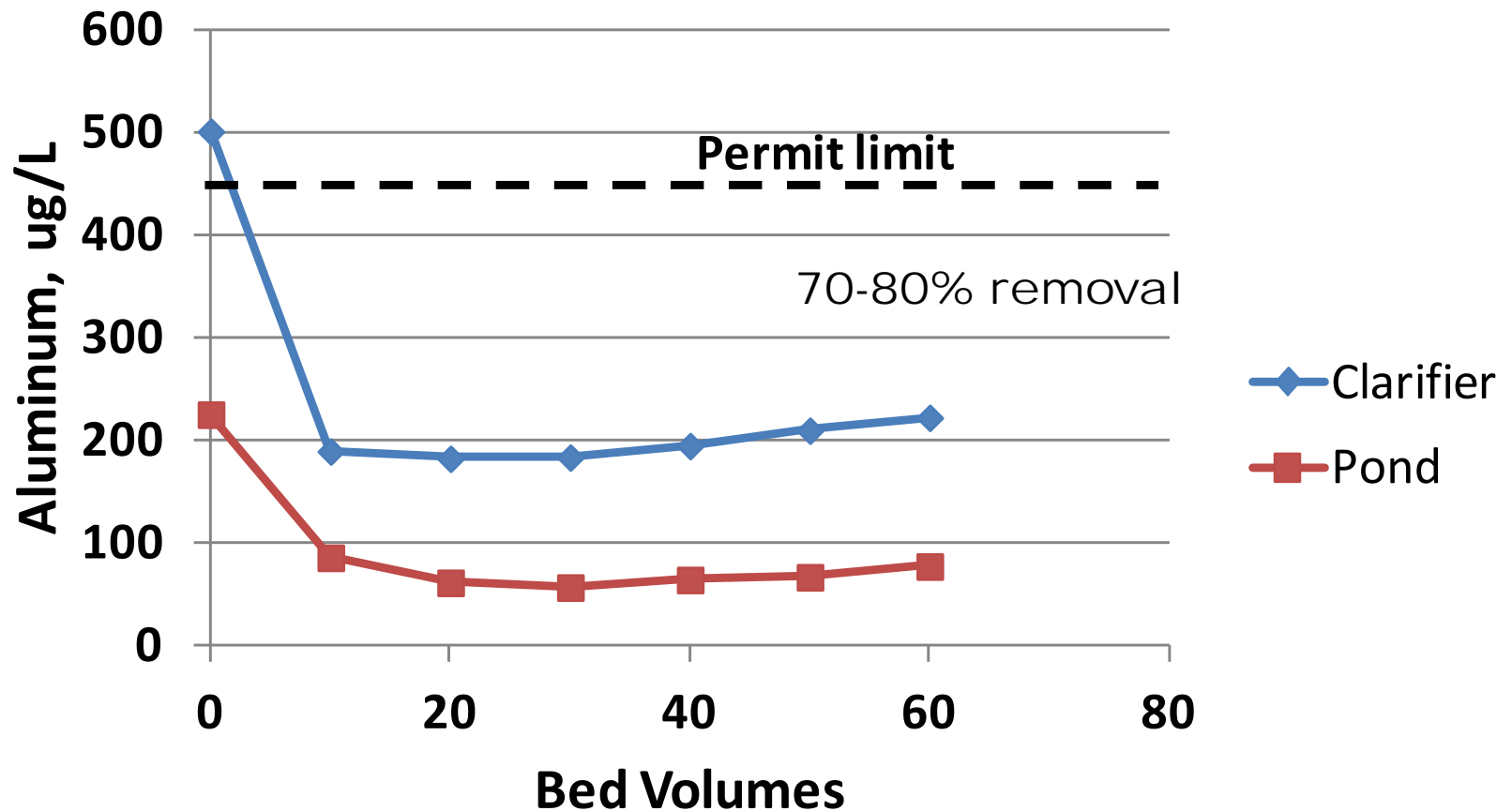
Column Test

Diameter 1 in
Length 8 in
Flow Rate 10ml/min
Contact Time 10 min

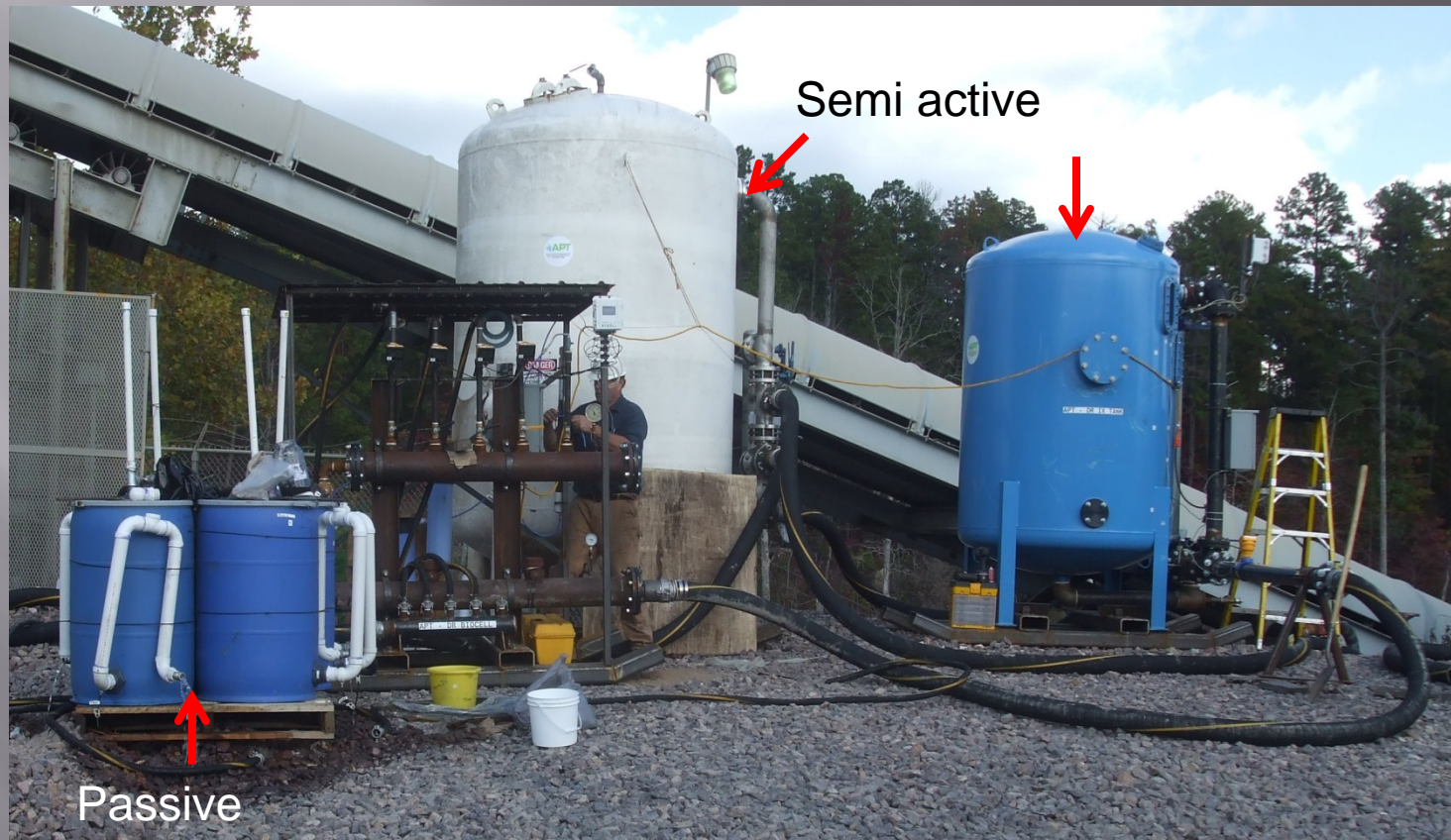


Results

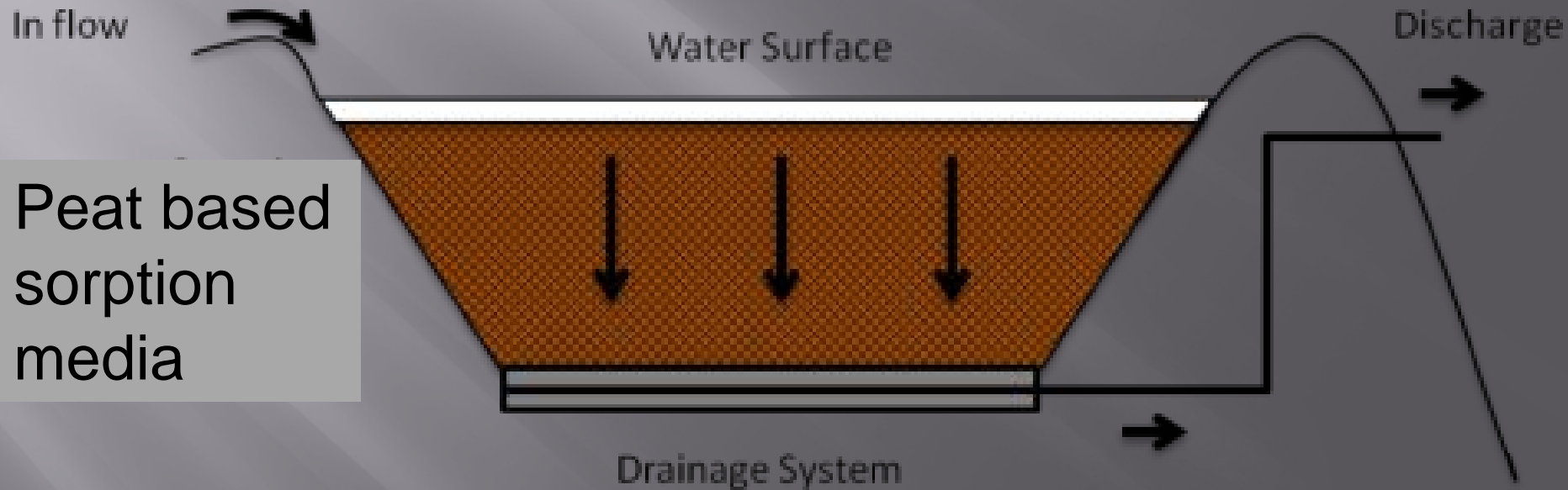
Aluminum Removal



Application



Passive filter bed





Summary

- ▣ Peat based sorption media effectively removes suspended metals
- ▣ Removes smaller particles than typical sand filter
- ▣ Cost effective
 - Semi active: < \$0.25 per 1000 gallons



On going projects

- ▣ Altering media
- ▣ Chemical modification
- ▣ Addition of functional group
- ▣ Target specific analytes



Ongoing Projects

Family of APTsorb™ products

Products	Market niche
APTsorb II	<ul style="list-style-type: none">Removal of heavy metals: Cd, Cu, Zn, Pb, etc.
APTsorb III	<ul style="list-style-type: none">Removal of heavy metals: Cd, Cu, Zn, Fe.No leaching of Mn, Fe, Ca into the effluentLower concentration of metals in the effluent
APTsorb II*Na	<ul style="list-style-type: none">High selectivity for Cd removal in the presence of Zn. Up to 3 mg/g Cd at influent Zn > 30 ppmStill evaluation other benefits.



Sulfate granule

Got Questions?



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**Global Minerals
Engineering**

Is this finally the end of the
shameless promotions?



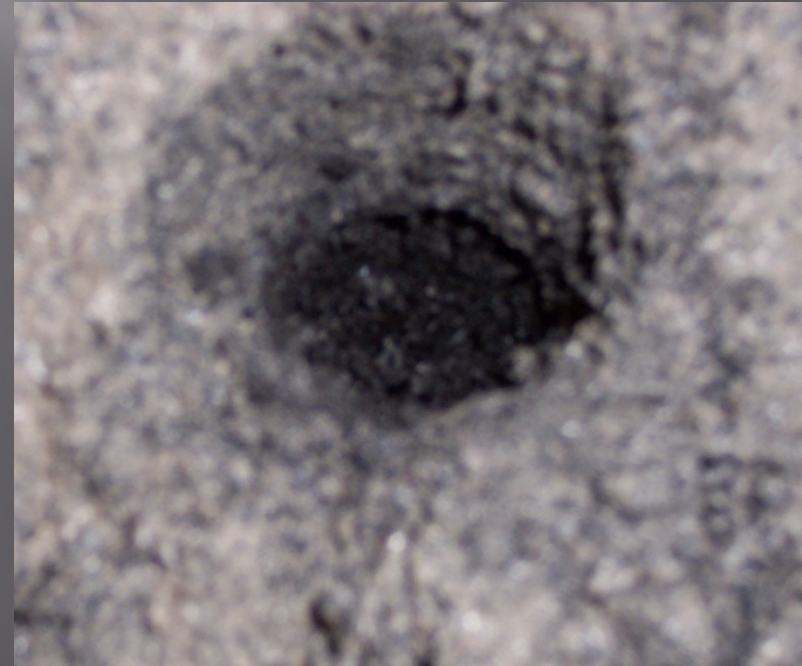
Passive – Biocells



When will
this end?



Solids, gravity flow



Solids, gravity flow



Passive – Biocells



Suspended Aluminum



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pH 7.7